Status Report: Effect of Faults on Groundwater Flow in the Carrizo-Wilcox Aquifer in Central Texas

Presentation to the Colorado and Lavaca Basin and Bay Stakeholder Committee

Presented by:

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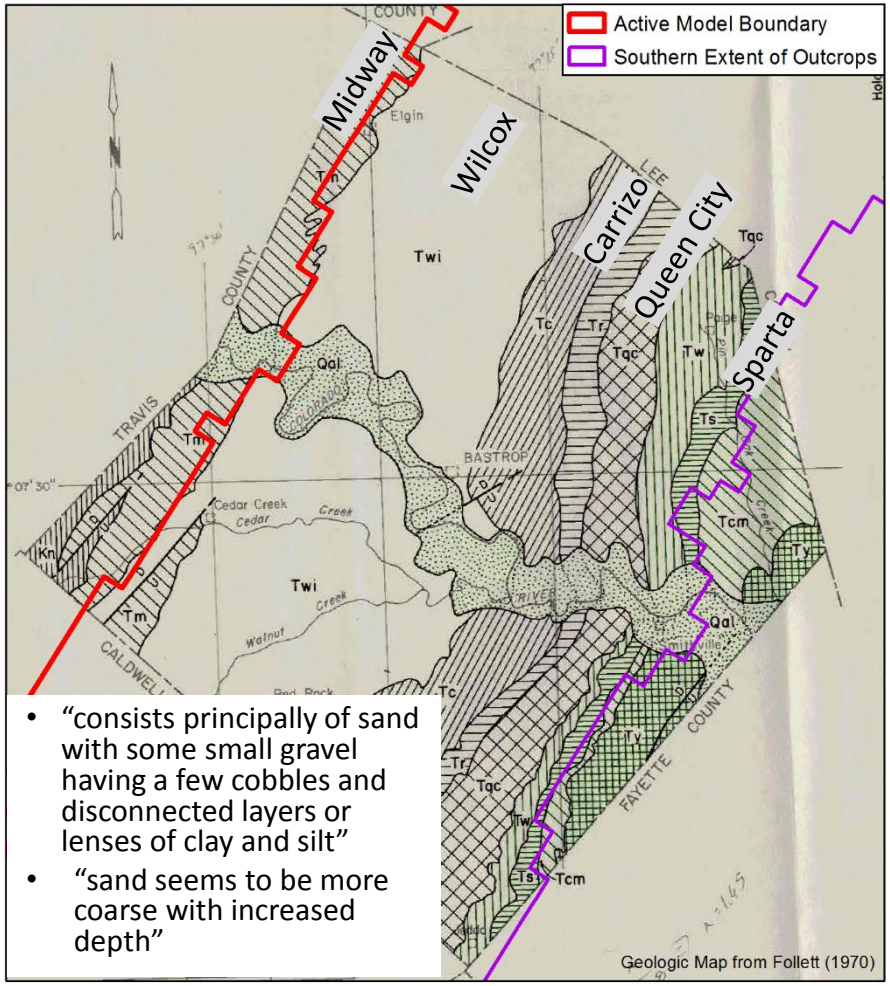
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

March 28, 2017

Topics

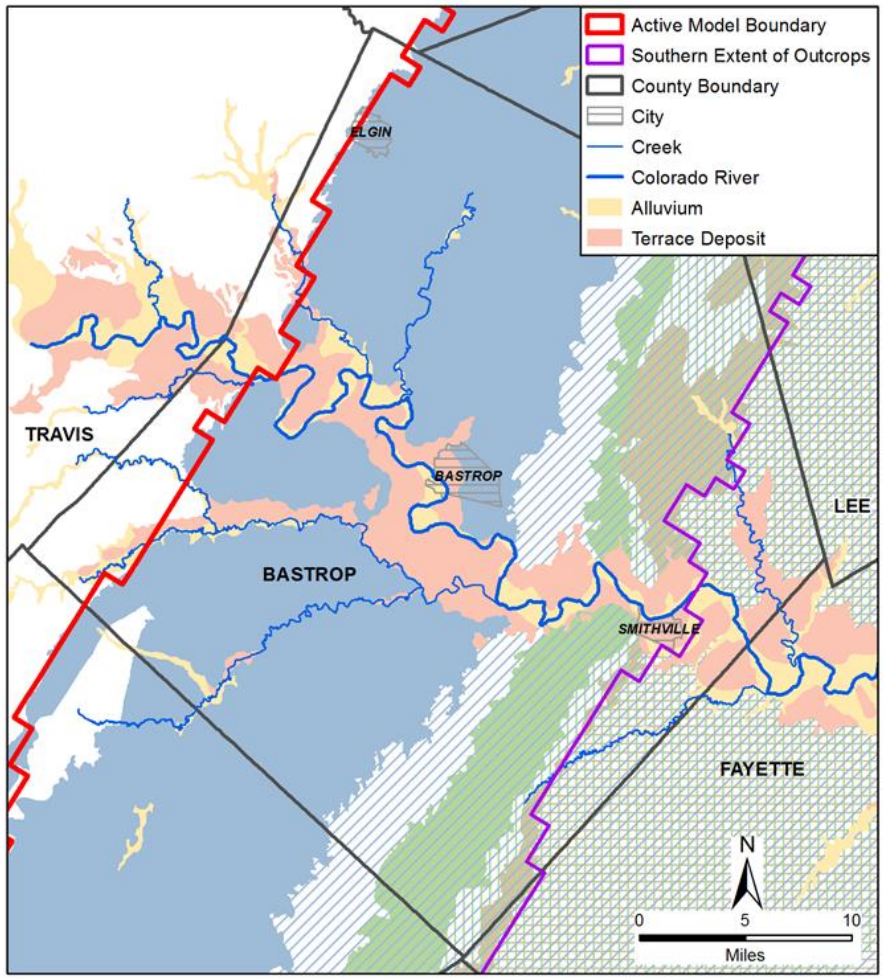
- Literature Review and Hydrogeologic Data Associated with Colorado Alluvium
- Additional Model Layer to Represent the Colorado Alluvium
- Refined Numerical Grid near Colorado River and Tributaries
- Next Steps

Literature Review: Alluvium Footprint



- "consists principally of sand with some small gravel having a few cobbles and disconnected layers or lenses of clay and silt"
- "sand seems to be more coarse with increased depth"

Groundwater Resources Bastrop County (1972)



Surface geology map (BEG, 1974)

Literature Review: Hydraulic Properties

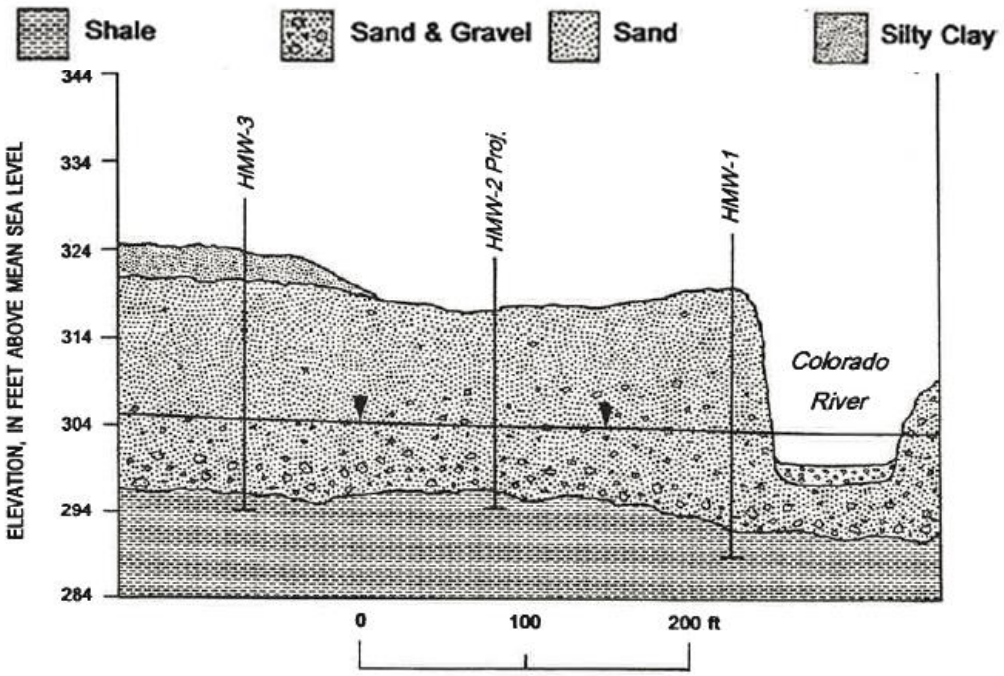
Hibbs and Sharp (1993)

- Hydraulic conductivity varies between 95 ft/day to 170 ft/day
- No stream bed resistence affect connection between Colorado River and Colorado alluvium
- Grain-size analysis data indicate a coarser lag gravel at base of the alluvium

Gerecht and others (1993)

- Hydraulic conductivity varies between 33 ft/day to 164 ft/day
- Vertical hydraulic conductivity is about 52 ft/day

Site #2 near City of Bastrop (Hibbs and Sharp, 1993)



Data Analysis: Wells Information from TWDB Databases

Estimate Base of Alluvium

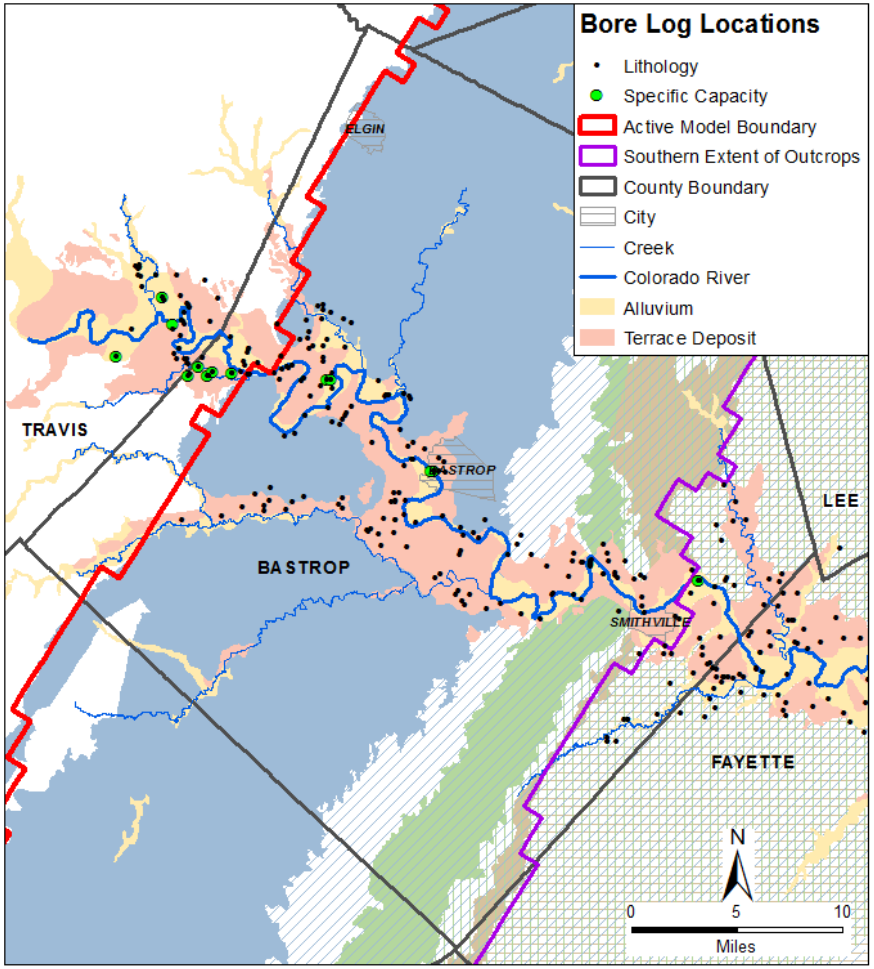
- 261 lithology profiles
- Base of gravel or coarse sandy deposit or top of a muddy/silty sequence

TDLR Well 156938		
Depth Interval (Ft.)	**Description**	**Unit**
0 - 11	Top Brown Sand	Alluvial System
11 - 20	Coarse Sand / Brown Clay	Alluvial System
20 - 45	Pea Gravel	Alluvial System
45 - 60	Pea Gravel / Large Gravel	Alluvial System
60 - 105	Gray Shale / Sandy Green Shale	Weches Formation
105 - 125	Grow-Brown Shale	Weches Formation
125 - 158	Gray-Brown Sand / Iron Rock	Weches Formation

Estimate of Transmissivity (ft^2/day)

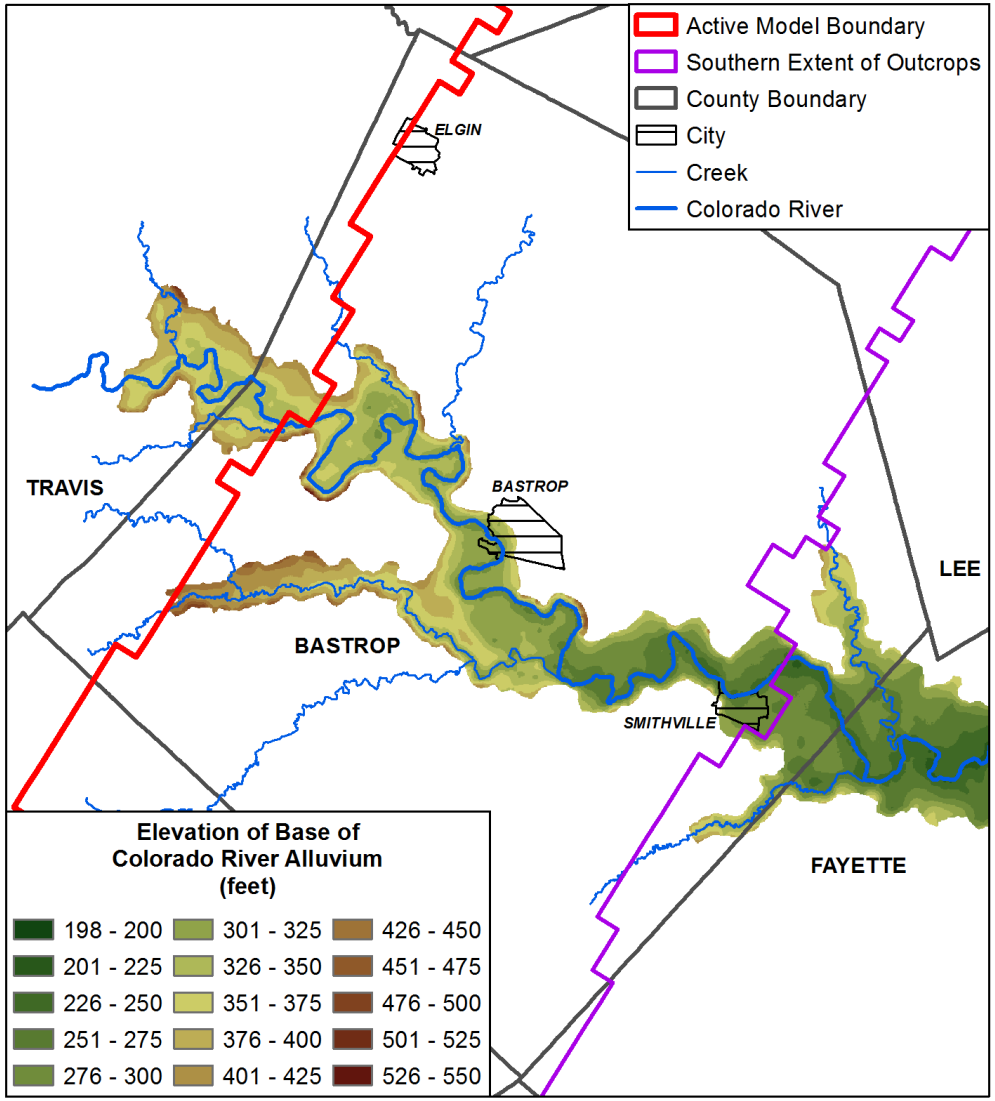
- 14 values
- Geometric mean of hydraulic conductivity is 75 ft/day

Alluvium Wells



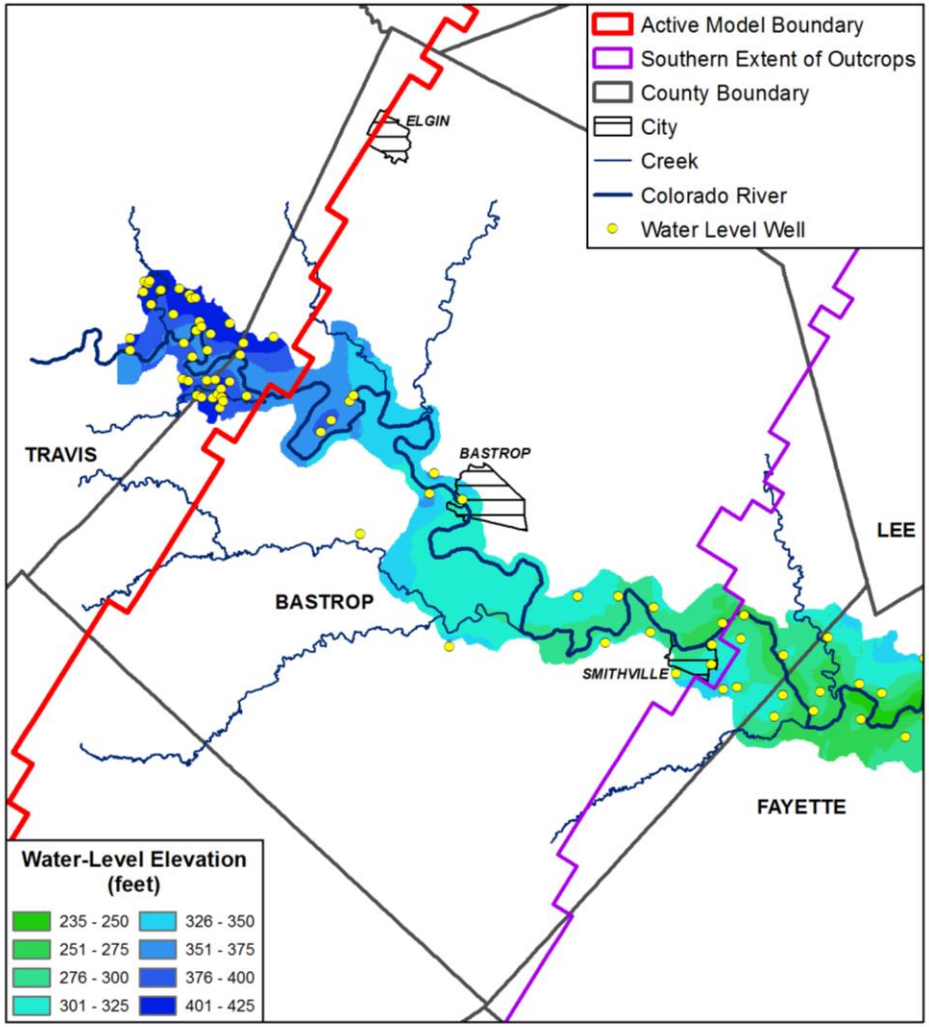
Colorado Alluvium: Preliminary Determination for Base Elevation

- Data
  - 260 well locations
  - Bathymetry from LCRA terrain map
  - Added control points where coverage was sparse. Depth estimated based on hydrogeologic studies
- Map
  - 0.25-mile by 0.25-mile grid cells
  - Area between red and purple lines will be represented in updated GAM



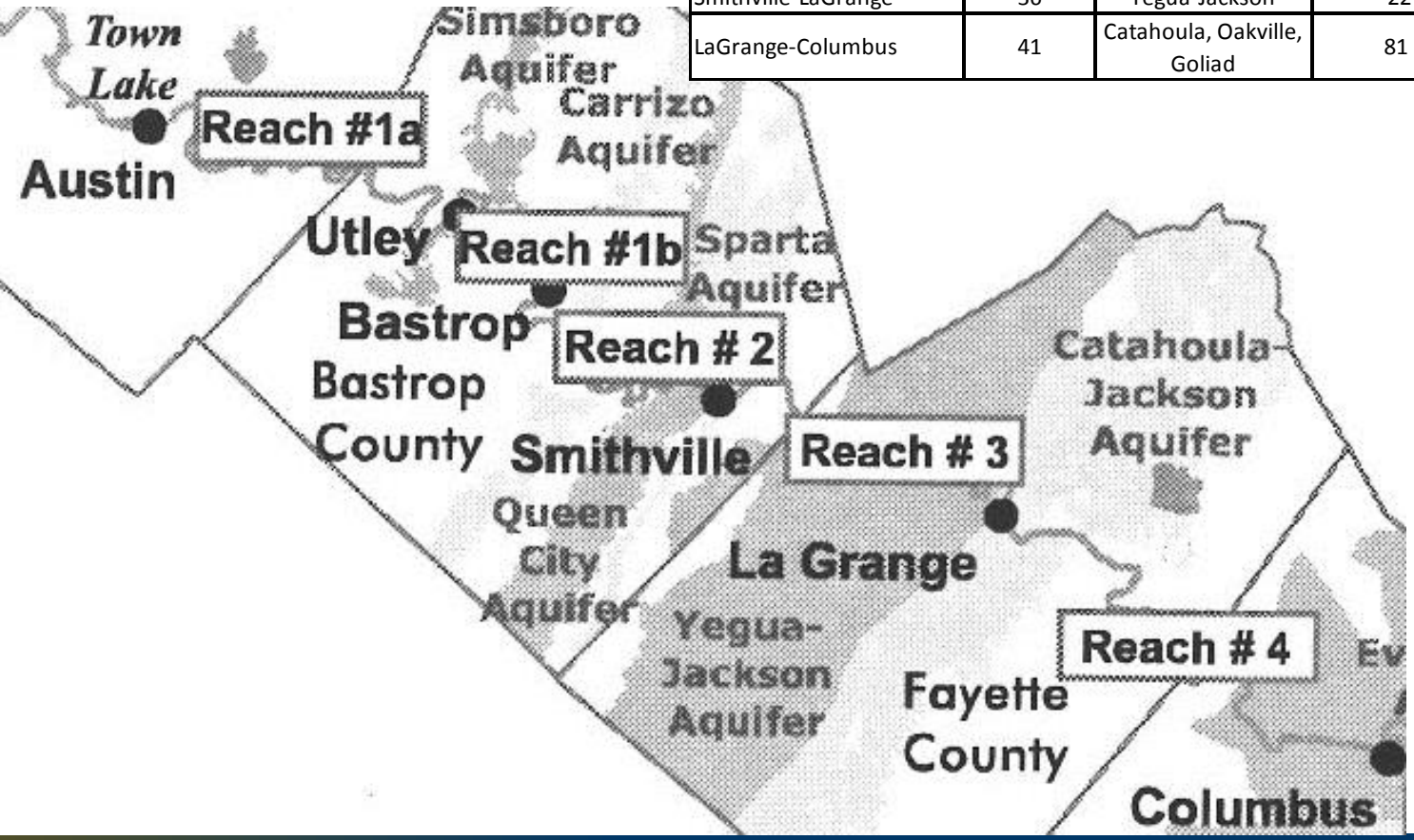
Colorado Alluvium: Water Levels from TWDB Databases

- Water levels from 80 wells
- Only one well with more than two water level measurements
- Used data qualitatively to evaluate flow directions
- Research studies indicate flow to river



Literature Review: LCRA Low-Flow Study (Saunders, 2006)

Description	River Mile Length (mi)	Water-bearing units	Median Adjusted Gain-Loss (cfs)	Watershed Area (mi^2)	Average Baseflow (in/yr)
Austin-Bastrop *	54	Simsboro	-9	967	NA
Bastrop-Smithville **	25	Calvert Bluff, Carrizo, Queen City, Sparta	59	458	1.8
Smithville-LaGrange	36	Yegua-Jackson	-22	606	NA
LaGrange-Columbus	41	Catahoula, Oakville, Goliad	81	581	1.9



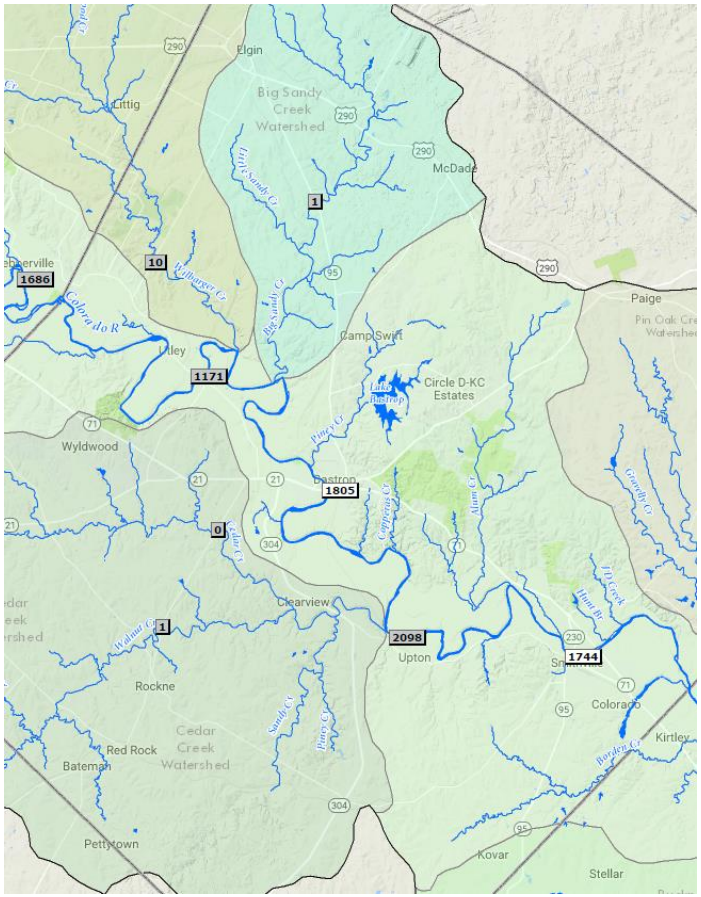
**9 cfs is less than potential error with stage-discharge rating associated with gauges

**Saunders (2009) estimates 30 cfs, TBWE (1960) estimates 36 cfs

Literature Review: LCRA Hydromet Network and DROM

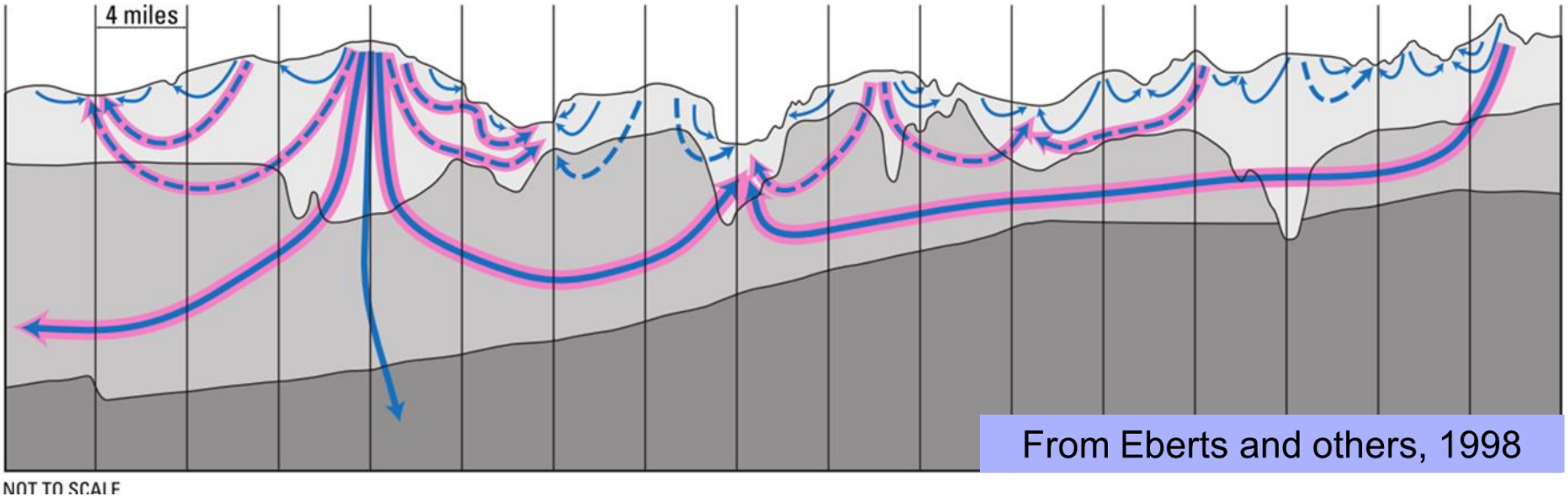
LCRA Daily River Operations Model (DROM)

- Uses the RiverWare modeling platform
- Hourly Routing Model simulates flow in the lower Colorado River
- Used to estimate gains and losses between gauges
- Accounts for:
  - Lake Travis releases
  - Tributary inflows
  - Downstream diversions
  - Austin return flows
- Ungauged flows include storm runoff and groundwater contributions
- Gauge uncertainty, flow variability (routing changes), and other issues can affect accuracy
- During dry periods, groundwater gain/loss can be estimated with greater accuracy



http://hydromet.lcra.org/full.aspx

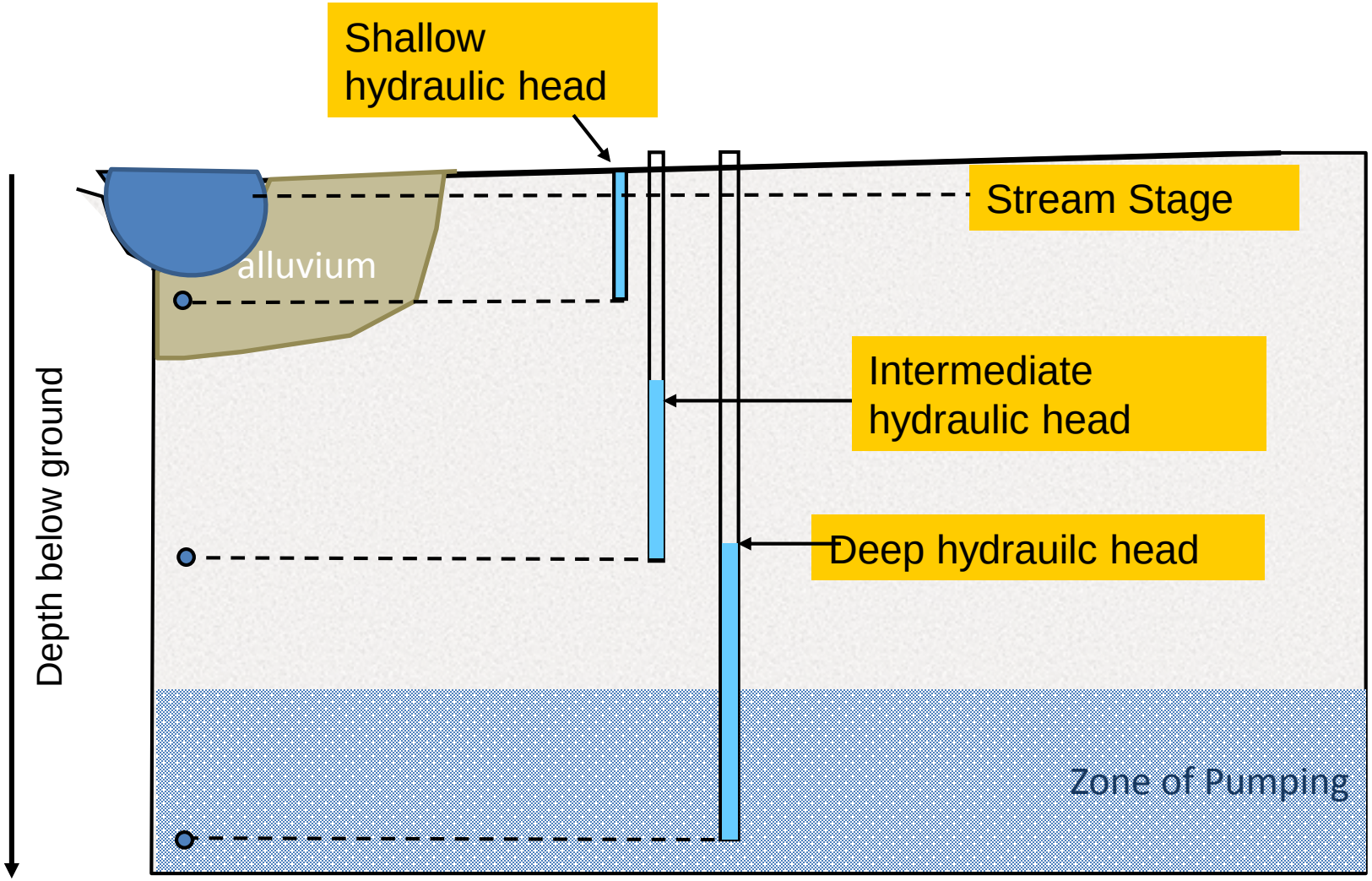
Hierarchy of Groundwater Flow Systems



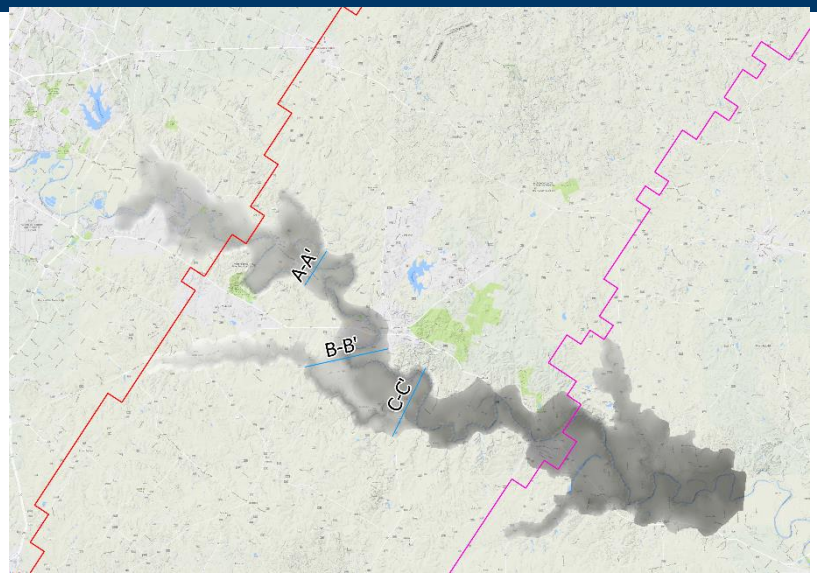
From Eberts and others, 1998

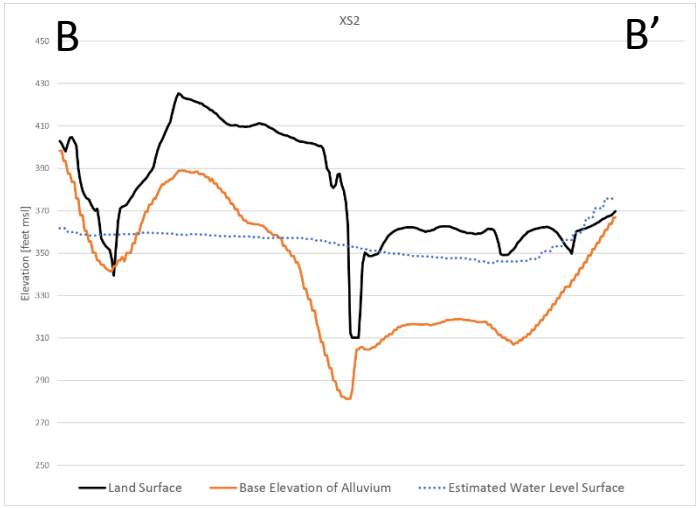
Note: Most GAMs and regional groundwater flow models do not have the vertical resolution in their layering to represent local flow paths.

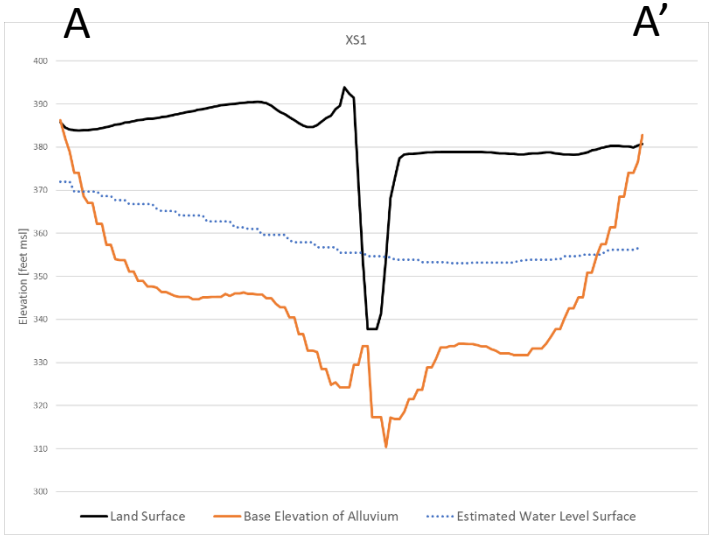
Addition of a Colorado Alluvium Layer: Support the Creation of a Shallow Flow Zone

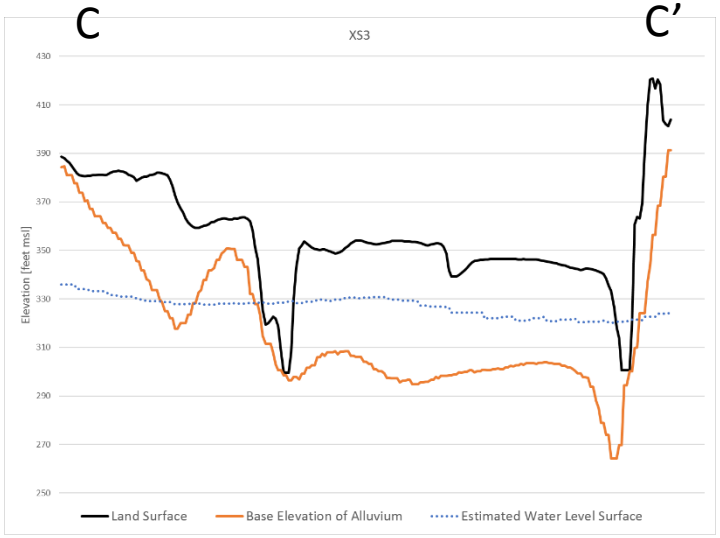


Addition of a Colorado Alluvium Layer: Examples



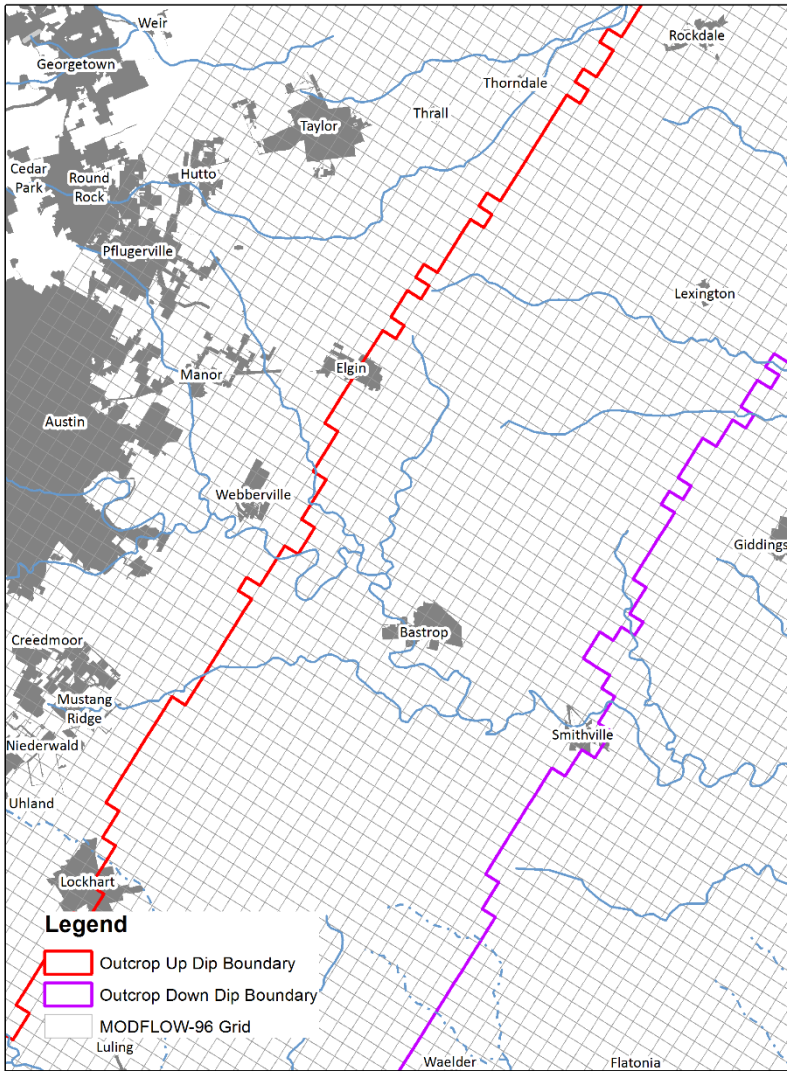




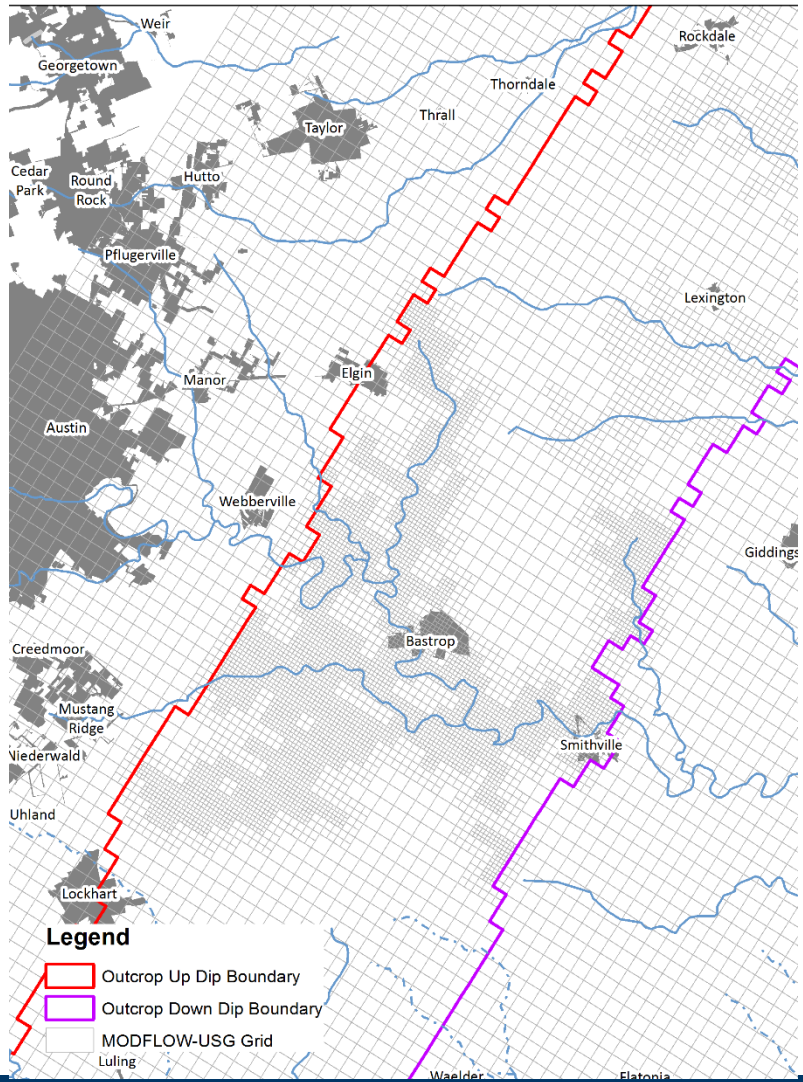


Comparison of Model Grid Cells in Vicinity of Colorado River: MODFLOW 96 and MODFLOW-USG

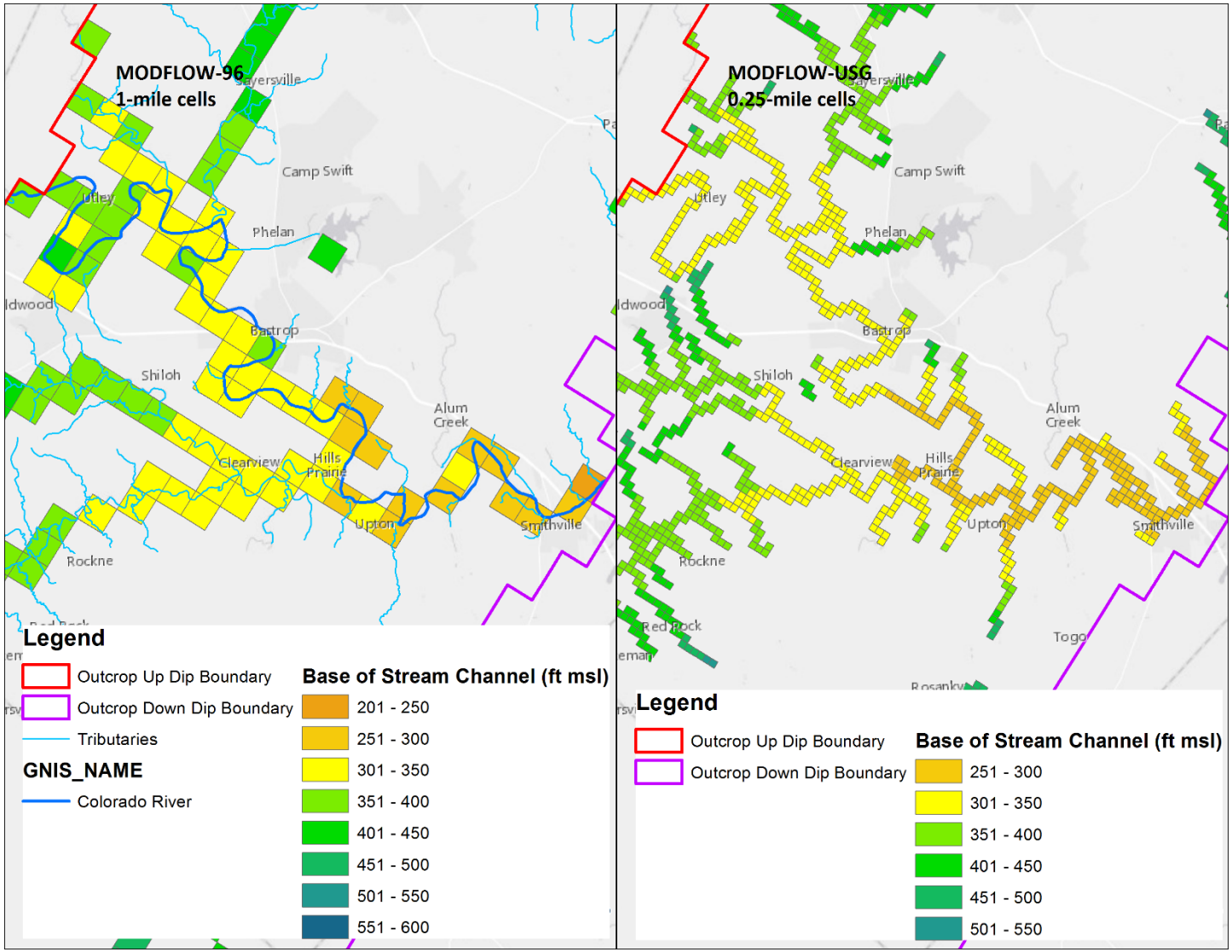
MODFLOW 96 Grid



MODFLOW-USG Grid



Comparison of Colorado River Location: MODFLOW 96 and MODFLOW-USG



Planned Activities

- Investigate possible benefits of Using LCRA DROM as a tool for characterizing GW-SW interaction
- Develop comprehensive work plan for GW-SW interactions
  - Paired stream gauge –groundwater well locations
  - Methodologies and costs for field work
  - Proposed hydrograph separation techniques
  - Possible partnerships or funding sources
- Submit Draft Report on June 30, 2017
  - Literature Search
  - Update on progress of revised GAM
  - Work Plan
- Submit Final Report on August 31, 2017


Questions ?